



HUMAN PHYSIOLOGY AND CLINICAL BIOCHEMISTRY

Topic: Circulation

Lecture 2

Components of Blood

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REFERENCE: OPEN ACCESS



Types of White Blood Cells

- White blood cells, or leukocytes, protect against disease.
- Leukocytes develop from hematopoietic stem cells in the red bone marrow in response to hormones, much as red cells form from precursors upon stimulation from EPO.
- These hormones fall into two groups—interleukins and colony stimulating factors (CSFs).
- Interleukins are numbered, whereas most colony-stimulating factors are named for the cell population they stimulate. Blood transports white blood cells to sites of infection. White blood cells differ in size, the nature of their cytoplasm, the shape of the nucleus, and their staining characteristics, and they are named for these distinctions.
- Leukocytes with markedly granular cytoplasm are called granulocytes , whereas those with less obvious cytoplasmic granules are called agranulocytes .
- Granulocytes develop in red bone marrow and about twice the size of a red blood cell.
- Members of this group include neutrophils, eosinophils, and basophils.
- They have a short life span, averaging about twelve hours.

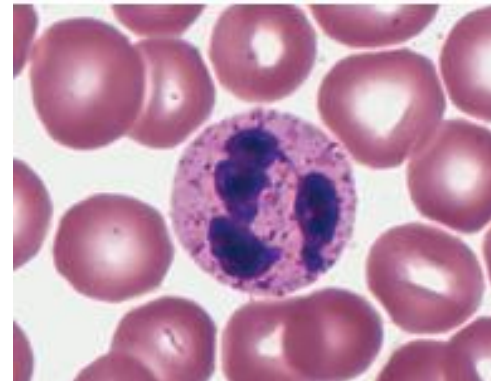
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Granulocytes

Neutrophils

- have fine cytoplasmic granules that appear light purple with a combination of acid and base stains.
- The nucleus of a more mature neutrophil is lobed and consists of two to five sections connected by thin strands of chromatin.
- They are also called polymorphonuclear leukocytes (PMNs) due to the variation of nucleus shape from cell to cell.
- Neutrophils are the first white blood cells to arrive at an infection site. These cells phagocytize bacteria, fungi, and some viruses.
- Neutrophils account for 54% to 62% of the leukocytes in a typical blood sample from an adult.



A neutrophil has a lobed nucleus with two to five segments (2,000×).

REFERENCE: OPEN ACCESS



Granulocytes

Eosinophils

contain coarse, uniformly sized cytoplasmic granules that stain deep red in acid stain, the nucleus usually has two lobes.

Eosinophils moderate allergic reactions and defend against parasitic worm infestation.

These cells make up 1% to 3% of the total number of circulating leukocytes.

Basophils

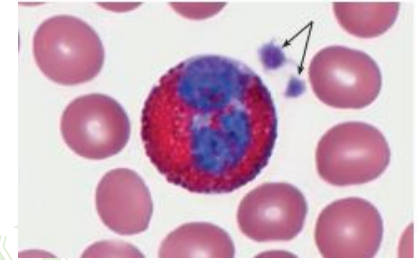
are similar to eosinophils in size and in the shape of their nuclei.

They have fewer, more irregularly shaped cytoplasmic granules than eosinophils, and these granules appear deep blue in basic stain.

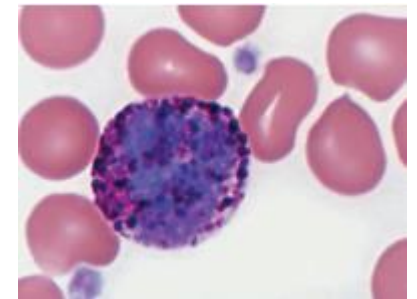
A basophil's granules can obscure a view of the nucleus.

Basophils usually account for less than 1% of the leukocytes.

Basophils migrate to damaged tissues where they release histamine, which promotes inflammation, and heparin, which inhibits blood clotting, actions that increase blood flow to injured tissues.



An eosinophil has red-staining cytoplasmic granules (2,000×). Note the platelets indicated by the arrows.



A basophil has cytoplasmic granules that stain deep blue (2,000×).



Agranulocytes

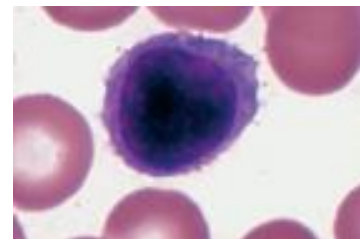
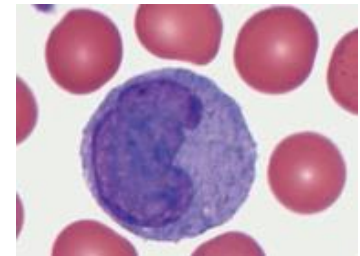
Agranulocyte include monocytes and lymphocytes.

Monocytes

- The largest of the white blood cells, are two to three times greater in diameter than red blood cells.
- Their nuclei are spherical, kidney-shaped, oval, or lobed.
- Monocytes leave the bloodstream and become macrophages that phagocytize bacteria, dead cells, and other debris in the tissues.
- They usually make up 3% to 9% of the leukocytes in a blood sample and live for several weeks or even months.

Lymphocytes

- the smallest of the white blood cells, are only slightly larger than erythrocytes.
- A typical lymphocyte has a large, spherical nucleus surrounded by a thin layer of cytoplasm.
- The major types of lymphocytes are T cells and B cells, which are both important in immunity.
- T cells directly attack microorganisms, tumor cells, and transplanted cells B cells produce antibodies, which are proteins that attack foreign molecules.
- Lymphocytes account for 25% to 33% of the circulating leukocytes. They may live for years



REFERENCE: OPEN ACCESS

REFERENCE: Human Physiology: Guyton

Open access



Leukocytes can squeeze between the cells that form the walls of the smallest blood vessels.

This movement, called diapedesis, allows the white blood cells to leave the circulation. A series of proteins called cellular adhesion molecules help guide leukocytes to the site of injury.

Once outside the blood, leukocytes move through interstitial spaces using a form of self-propulsion called amoeboid motion.

The most mobile and active phagocytic leukocytes are neutrophils and monocytes.

Neutrophils cannot ingest particles much larger than bacterial cells, but monocytes can engulf larger structures.

Monocytes contain many lysosomes, which are filled with digestive enzymes that break down organic molecules in captured bacteria.

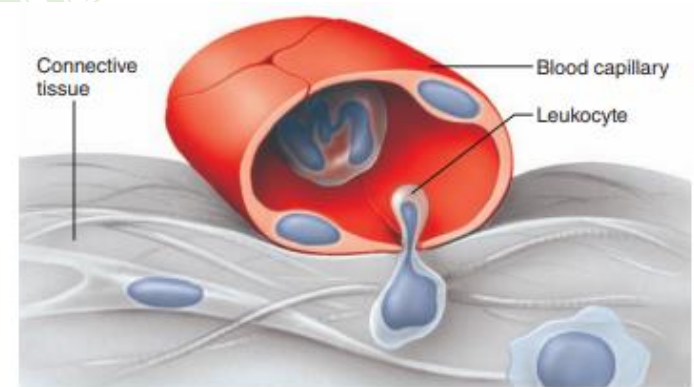


FIGURE 14.15 In a type of movement called diapedesis, leukocytes squeeze between the endothelial cells of a capillary wall and enter the tissue space outside the blood vessel.

REFERENCE: OPEN ACCESS

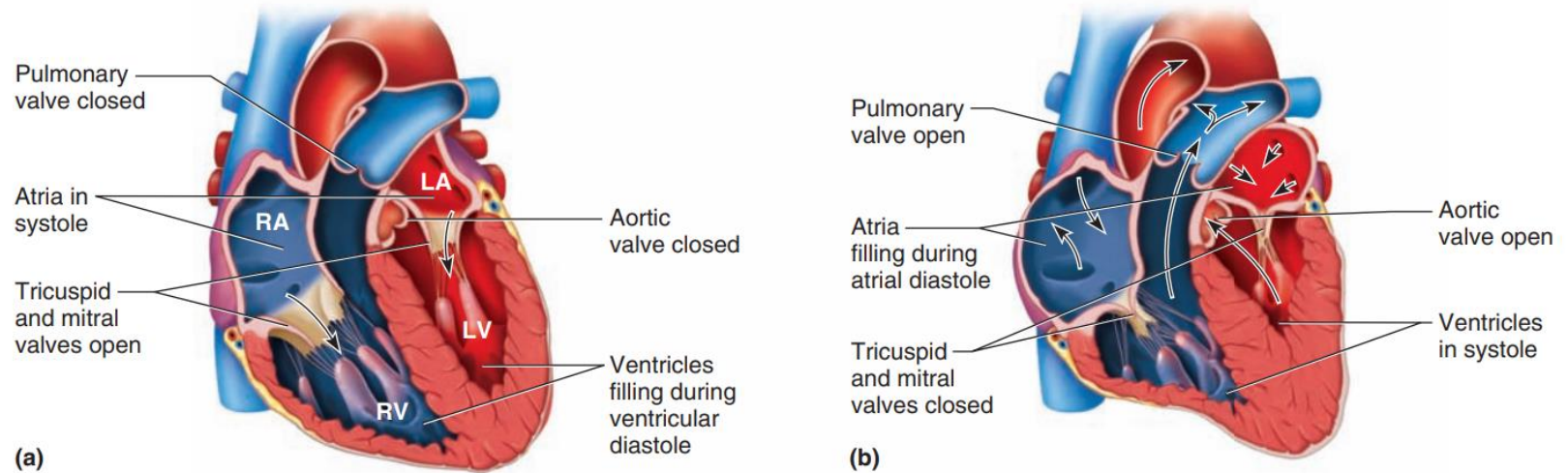
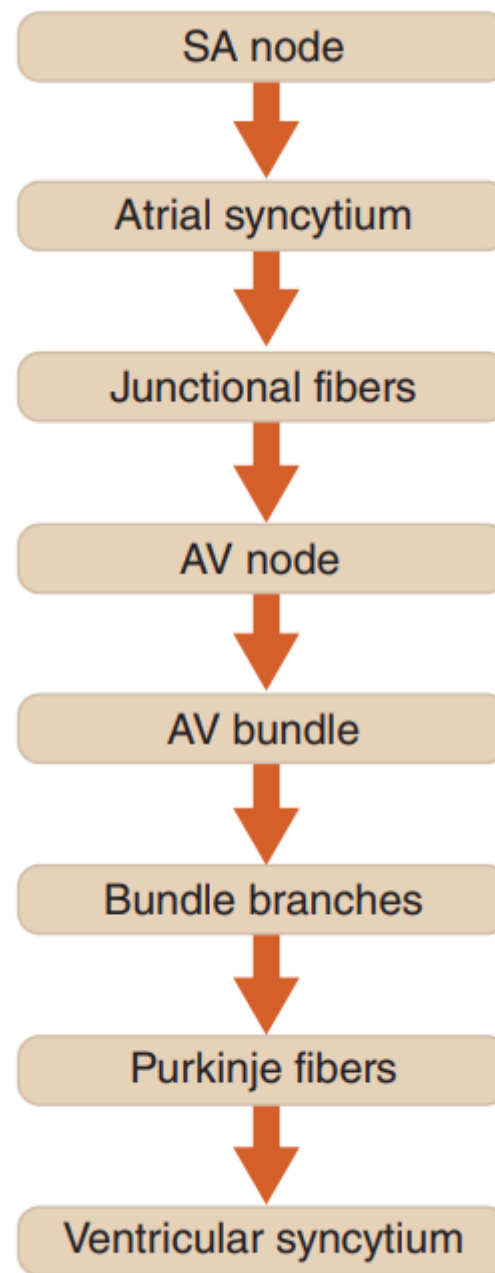


FIGURE 15.14 **AP|R** A cardiac cycle. The atria (a) empty during atrial systole and (b) fill with blood during atrial diastole.

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Path of a cardiac impulse.

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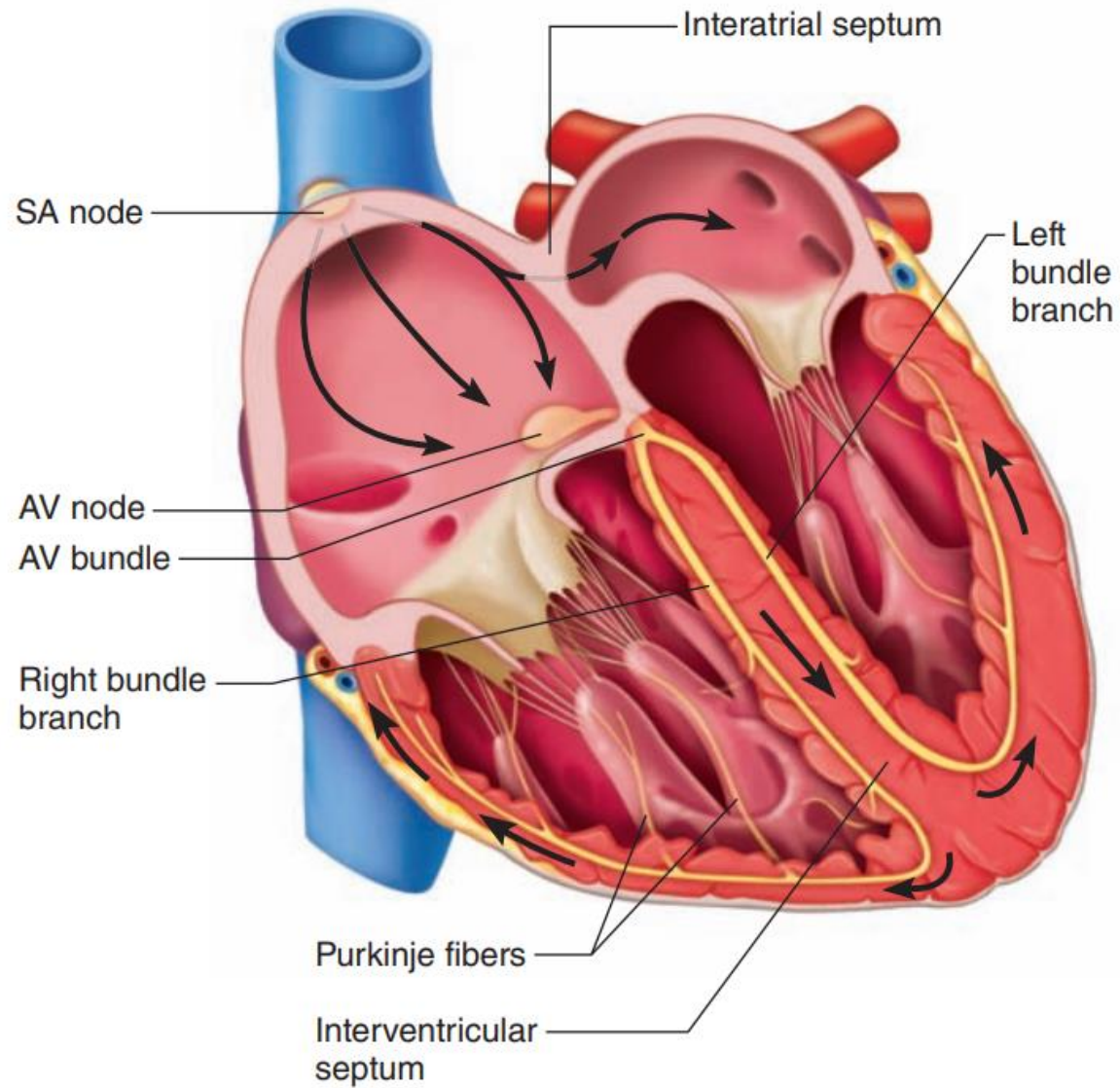


FIGURE 15.16 **AP|R** Components of the cardiac conduction system.

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